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Inquiline insects of the honey bee *Apis mellifera* in Western Siberia (Hymenoptera, Apidae)

Victoria V. Stolbova[1], Vitaly A. Stolbov[2]

1 *All-Russian Scientific Research Institute of Veterinary Entomology and Arachnology – a Branch of the Federal State Budgetary Institution of Science of the Federal Research Center of the Tyumen Scientific Center of the Siberian Branch of the Russian Academy of Sciences, Tumen, Russia* **2** *Tyumen State University, Tyumen, Russia*

Corresponding author: Victoria V. Stolbova (victorysva@mail.ru)

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Abstract

The multi-species associations of insects (symbiocenosis) in honey bee hives currently include more than 15 orders of Insecta. We present the results of studying the inquilines of bee hives in the south of Western Siberia. In the honeybee hives of this region 37 insect species from 8 orders (Dermaptera, Thysanoptera, Psocoptera, Hemiptera, Coleoptera, Hymenoptera, Lepidoptera, Diptera) were identified. Inquiline insects were observed in 77% of hives in 81.5% of the studied apiaries. Coleoptera prevailed among the orders, accounting for 94% of observations. The overall eudominant was *Cryptophagus scanicus* (Linnaeus, 1758) (87.8%); the subdominants were *Dermestes lardarius* Linnaeus, 1758 and *Contacyphon variabilis* (Thunberg, 1787). The smallest number of insect species can be attributed to specific groups. These are *C. scanicus*, a detritophage that primarily feeds on mold fungi hyphae, but can also consume bee supplies; and *Galleria melonella* (Linnaeus, 1758), a widespread pest of bee colonies, that feeds on bee bread, honey, wax and bee brood. The facultative group includes detritophages, pollen- and honey-feeding species, that find suitable conditions for feeding and developing in beehives (Vespidae, Formicidae, etc.). Representatives of accidental group were the most diverse in species composition and type of nutrition but they were always individually found in hives. In total, 42 species of insects are currently recorded in the beehives of Western Siberia.

Keywords

Bee hives, beekeeping, Coleoptera, *Galleria melonella*, honey bee hives, Insecta

Introduction

The honey bee nest is an apiophilic symbiocenosis of the nidicolous (nest) type (Sidorov 1968). A honeybee hive can be considered an artificial nidicolous ecotope – a community habitat with sufficient ventilation and a relatively stable microclimate that provide favorable conditions for symbionts – consortium members (Bakalova 2011a).

Arthropods are an integral part of bee hive biocenosis. Mites and insects are the main symbionts of bees, predominant in quantity and taxonomic diversity (Stolbova 2022).

Insects (Insecta) show the most diversity in apiophilic symbiocenoses, to date representatives of the Collembola and 14 orders insects have been noted: Zygentoma, Blattodea, Dermaptera, Psocodea, Thysanoptera, Heteroptera, Coleoptera, Hymenoptera, Neuroptera, Raphidiodea, Lepidoptera, Mecoptera, Diptera, Siphonaptera (Orösi Pal 1939; Sidorov 1968; Banaszak 1980; Bakalova 2011a; Semmar et al. 2014). The total number of insects found in honeybee hives amounts to several hundred species (Bakalova 2011a).

The most numerous insect symbionts of bees are Coleoptera (Sidorov 1968). According to the latest data, the list of beetles in honeybee hives includes 155 species from 30 families (Bakalova 2011a).

Among insects, there are both specific species whose entire life cycle is tied to bees, and numerous facultative species that visit hives periodically, or enter them accidentally, for example, in search of shelter for wintering.

A range of insect species is serious pests of beekeeping, primarily the greater wax moth *Galleria mellonella* (Linnaeus, 1758) and the lesser wax moth *Achroea grisella* (Fabricius, 1794). Some Coleoptera are also serious pests, in particular, *Aethina tumida* Murray, 1867, which has been actively settling in different countries in recent years (Neumann et al. 2016).

A number of researchers believe that wasps occupy the first place among the pests of honey bees from the insect class, in terms of damage caused. To date, there are 26 species and subspecies of honey bee pest wasps from 6 genera and 2 families (Pusceddu et al. 2017; Konovalova 2018). There are over 50 species of Diptera associated with bees, most of them are parasitoids (Zimina 1973; Bakalova 2011a).

In addition to the direct harm caused to bees, many insects can be carriers of fungal spores and viruses that cause diseases of bees, such as nosematosis, ascospherosis, etc. Beetles transfer mold spores and *Nosema apis* (Zander, 1909) microsporidia from the bottom of the hive to the honeycomb of the brood nest or from one hive another. It was found that single adult individuals of *Tribolium madens* (Charpentier, 1825) and *Dermestes lardarius* Linnaeus, 1758 can carry about 150 and 285 thousand spores of *Ascosphaera apis* (Maasen ex Claussen) Olive & Spiltoir, 1955 – the causative agent of ascospherosis of bees on the surface of their bodies (Measures to control beetles 1998).

However, most of the insects found in hives are commensals, which often not only do not harm beekeeping but on the contrary, are useful. First of all, these are detritophages, which dispose of garbage, mold fungi and dead bees from the bottom of hives. These include beetles, earwigs, cockroaches. These species feed on the waste

of bee colonies (wax crumbs, contaminated bee bread, feces and corpses of bees) and thus, contribute to the cleaning of the honey bee nest.

No less important for bee symbiocenosis are predatory insect species that regulate the number of other arthropods in the hive. This group includes beetles (Carabidae, Staphilinidae, Coccinellidae, etc.), Hymenoptera (Vespidae, Formicidae), Raphidioptera, Chrysopidae, etc. (Bakalova 2011a). Permanent predatory species of hive symbionts, as a rule, are mutualists in relation to bees but facultative species ones can be harmful (Measures to control beetles 1998).

There are quite a large number of papers on bee symbionts, however, most of them cover individual practically significant species, such as *Varroa destructor* ticks Anderson & Trueman, 2000, wax moth, small hive beetle and other bee parasites and pests. The most complete reports on the entomofauna of bee hives were obtained quite a long time ago, and mainly cover Europe (Orösi Pal 1939; Banaszak 1980). These papers describe the composition of symbionts give general data on their ecology.

A number of works are available on the European part of Russia and the Caucasus (Sidorov 1968; Atakishiev 1969; Pushkin 2009; Bakalova 2011a). At the same time, in all the above works, the emphasis was placed either on individual groups of symbionts (according to the degree of harmfulness to bees), or on specific conditions of detention (bee-trees, wild hive).

In Siberia, there are papers on specific groups of symbiont insects (Coleoptera, earwigs) (Zbanatsky 1997b; Domatsky and Domatskaya 2020). At the same time, considering the symbiocenosis of the nidicolous type, all members of which are important for its full functioning, it is necessary to study all bee symbionts in the complex.

Earlier, we studied in detail the composition of the acarofauna of honey bee hives in Western Siberia (Stolbova 2022). This paper considers entomofauna.

Material and method

The topic was studied in 2020–2022 in the south of Western Siberia, within the southern taiga and forest-steppe zones. The short summer period in this region is characterized by high temperatures, the winter period is long and severe (5–6 months), with frequent frosts. The main breed of bees in the region is *Apis m. mellifera* Linnaeus, 1758, but beekeepers also contain other breeds, such as the *Apis m. carpathica* Avetisyan, Gubin & Davidenco, 1966, *Apis m. carnica* Pollmann, 1879, and *Apis m. buckfast*, thus most of the bees in Western Siberia are mixed (Pashayan and Endovitsky 2018).

A total of 193 bee colonies from 27 apiaries from 20 settlements in the south of the Sverdlovsk Oblast, Tyumen Oblast and Altai Krai were studied. Collection from the south of the Tyumen Oblast prevailed. A detailed description of the collection points is to be found in (Suppl. material 1).

For the study, dead bees, wax and bee bread crumbs, and waste from the bottom of hives were collected in paper bags, labelled and delivered to the laboratory. Part of the material was selected and provided to the laboratory by apiaries owners.

To study the qualitative and quantitative composition of the bee hive fauna, the same amount of dead bees was taken from the selected or received material in the laboratory, the quantity was a standard completely full Falcon-type test tube (volume 50 ml). The sample was filled with water and kept for 1–2 hours, periodically turning the tube over to mix the contents. After that, the sample was carefully examined under a stereomicroscope against a dark background.

Some of the samples were pre-treated in Berlese funnel for 2 weeks until the substrate was completely dry. After that, the dry residue was examined under a stereomicroscope.

Thysanoptera, Psocoptera, Hemiptera, Hymenoptera (Formicidae, Parasitica), Diptera insects and all insect larvae were fixed in 70% alcohol, the rest were placed on entomological mattresses. Coleoptera and Hemiptera were subsequently mounted on entomological plates. Psocoptera were mounted on slides using Hoyer's medium. Taxonomic identification of symbionts was made using identification guides, scientific articles and Internet resources (Bey-Bienko 1965; Ler 1992; Lyubarsky 2002; Ellis et al. 2013; Opit G et al. 2022).

Statistical data processing was carried out in the Microsoft Excel 2016 program. In this paper, the following terms are used: abundance – the number of insects per infected sample (min–max, average, ex.); occurrence – the number of samples (bee colonies) with insects, as a percentage of the number of samples studied; dominance index – the number of individuals of this species to the total number of individuals of all detected species (%).

Results

A total of 37 insect species were identified (Table 1). Some of the insects were identified only to genus or family, since many specimens lacked diagnostic features. Identification of larvae was often especially difficult.

Nine insect species were found in bee hives for the first time: *Cryptophagus hauseri*, *Sciodrepoides watsoni*, *Phyllobius contemptus*, *Epuraea biguttata*, *E. boreella*, *Brachypterus fulvipes*, *Litargus connexus* (Coleoptera), *Scolopostethus pictus* and *Rhyparochromus pini* (Heteroptera).

In addition to these species, *Forficula tomis*, *Formica rufibarbis* and *Liposcelis bostrychophila* were recorded in bee brood nests in Western Siberia for the first time.

Other insect species were regularly observed in honey bee hives, including in Western Siberia.

In numbers of species, the Coleoptera predominated, which accounted for half (18) of all identified insect species. Hymenoptera were also quite numerous, at the same time the particular spices of Parasitica representatives were not identified. The remaining orders were represented by just one or two species.

Symbiont insects were observed in 81.5% of the studied apiaries (Table 2). The occurrence in the studied bee hives was 77%.

Both in terms of occurrence, and especially in number, representatives of Coleoptera prevailed among the orders, which accounted for 94% of all insects detected.

Table 1. Species composition, occurrence and abundance of insects in the studied bee hives of Western Siberia.

Taxon	Total number	Abundance, min-max (median)	Occurrence, %	Dominance index, %
Dermaptera				
Family Forficulidae				
Forficula tomis Kolenati, 1846	5	1–2 (1)	2.072	0.204
Thysanoptera				
Thysanoptera indet.	5	1–3 (2)	1.554	0.204
Psocoptera				
Family Liposcelididae				
Liposcelis bostrychophila Badonnel, 1931	9	1–3 (1)	3.108	0.367
Psocoptera indet.	1	1–1 (1)	0.518	0.040
Hemiptera				
Cicadoidea				
Cicadellidae gen. sp.	11	1–9 (1)	1.554	0.449
Aphidoidea				
Aphidoidea indet.	1	1–1 (1)	0.518	0.040
Heteroptera				
Family Anthocoridae				
Orius sp.	2	2–2 (2)	0.518	0.081
Family Rhyparochromidae				
Rhyparochromus pini (Linnaeus, 1758)	1	1–1 (1)	0.518	0.040
Scolopostethus pictus (Schilling, 1829)	1	1–1 (1)	0.518	0.040
Heteroptera fam. sp. Larva	1	1–1 (1)	0.518	0.040
Coleoptera				
Family Leiodidae				
Sciodrepoides watsoni (Spense, 1813)	2	2–2 (2)	0.518	0.081
Family Staphylinidae				
Aleocharinae gen. sp.	4	1–3 (2)	1.036	0.163
Family Scirtidae				
Contacyphon variabilis (Thunberg, 1787)	69	1–10 (3)	9.844	2.817
Contacyphon padi (Linnaeus, 1758)	1	1–1 (1)	0.518	0.040
Contacyphon pubescens (Fabricius, 1792)	2	2–2 (2)	0.518	0.081
Family Dermestidae				
Dermestes lardarius Linnaeus, 1758	6	1–2 (1)	2.590	0.244
Trogoderma sp.	1	1–1 (1)	0.518	0.040
Dermestidae Larvae	46	1–19 (4)	4.145	1.878
Family Kateretidae				
Brachypterus fulvipes Erichson, 1843	3	1–2 (1)	1.036	0.122
Family Nitidulidae				
Epuraea biguttata (Thunberg, 1784)	5	5–5 (5)	0.518	0.204
Epuraea borrella (Zetterstedt, 1828)	1	1–1 (1)	0.518	0.040
Family Cryptophagidae				
Cryptophagus scanicus (Linnaeus, 1758)	2150	1–150 (12)	52.332	87.791
Cryptophagus hauseri Reitter, 1890	7	1–2 (1)	3.108	0.285
Family Laemophloeidae				
Cryptolestes ferrugineus (Stephens, 1831)	5	2–3 (2.5)	1.036	0.204
Family Mycetophagidae				
Litargus connexus (Fourcroy, 1785)	1	1–1 (1)	0.518	0.040
Family Latridiidae				
Latridius sp.	1	1–1 (1)	0.518	0.040

Taxon	Total number	Abundance, min-max (median)	Occurrence, %	Dominance index, %
Cortinicara gibbosa (Herbst, 1793)	1	1–1 (1)	0.518	0.040
Family Curculionidae				
Phyllobius contemptus Schoenherr, 1832	1	1–1 (1)	0.518	0.040
Apion sp.	1	1–1 (1)	0.518	0.040
Hymenoptera				
Family Vespidae				
Vespula germanica (Fabricius, 1793)	17	1–5 (1)	3.626	0.694
Family Apidae				
Bombus lucorum Linnaeus, 1761	1	1–1 (1)	0.518	0.040
Family Formicidae				
Lasius niger (Linnaeus, 1758)	10	1–5 (1)	3.108	0.408
Formica rufibarbis Fabricius, 1793	1	1 (1)	0.518	0.040
Parasitica indet.	32	1–4 (1)	12.435	1.306
Lepidoptera				
Family Galleriidae				
Galleria mellonella (Linnaeus, 1758)	16	1–11 (1)	3.108	0.653
Diptera				
Family Drosophilidae				
Drosophila sp.	18	3–8 (7)	1.554	0.734
Family Phoridae				
Phoridae gen. sp.	4	1–2 (1)	1.554	0.163
Diptera indet.	6	6–6 (6)	0.518	0.244
Total	**2449**	**1–151 (9)**	**76.683**	**100**

Table 2. The occurrence of dominant symbiont species in colonies and apiaries.

Taxon	Occurrence in the studied colonies, %	Occurrence in the studied apiaries, %
Cryptophagus scanicus	52.3	54.5
Contacyphon variabilis	9.8	22.2
Dermestidae larvae	4.1	22.2
Vespula germanica	3.6	22.2
Liposcelis bostrychophila	3.1	18.5
Dermestes lardarius	2.6	14.8
Parasitica indet.	12.4	11.1
Phoridae gen. sp.	3.6	11.1
Cryptophagus hauseri	3.1	11.1
Galleria mellonella	3.1	11.1
Thysanoptera indet.	1.5	11.1
Cicadellidae gen. sp.	1.5	11.1
Lasius niger	3.6	7.4
Forficula tomis	2.1	7.4
Cryptolestes ferrugineus	1.0	7.4
Aleocharinae gen. sp.	1.0	7.4

The absolute dominant species was *Cryptophagus scanicus*, which, the preimaginal stages included, accounted for 93.2% of all beetles and 87.8% of all insects.

Two other species of Coleoptera, *Dermestes lardarius* and *Contacyphon variabilis*, also had a fairly high number: *D. lardarius*, larval stages included accounted for 2.1%

of all insects, and the second species took 2.8%. It is characteristic that in the most numerous symbionts – *C. scanicus* and *D. lardarius*, larval stages prevailed in the studied hives (88.4% and 88.5%, respectively).

Vespula germanica wasps, Parasitica and a greater wax moth also had a relatively high occurrence and abundance. The rest of the insect representatives were observed singly.

The occurrence of symbionts in different apiaries varied. Of the 37 insect species found, less than half (16) were recorded in two or more apiaries (44.4%).

The occurrence of symbionts among the studied bee colonies was not very high (Table 2), with the exception of *C. scanicus*, all species had an occurrence below 20%. However, the occurrence in the studied apiaries was significantly higher, while in the dominant species it almost did not change. This shows that the dominant species had a consistently stable high occurrence both in different apiaries and in bee colonies in the same apiary, while other insect species associated with bees were also regularly found in different apiaries of the studied region, although they had a lower number.

Discussion

The insects found in hives can be divided into several ecological groups that play different roles in hives (Fig. 1).

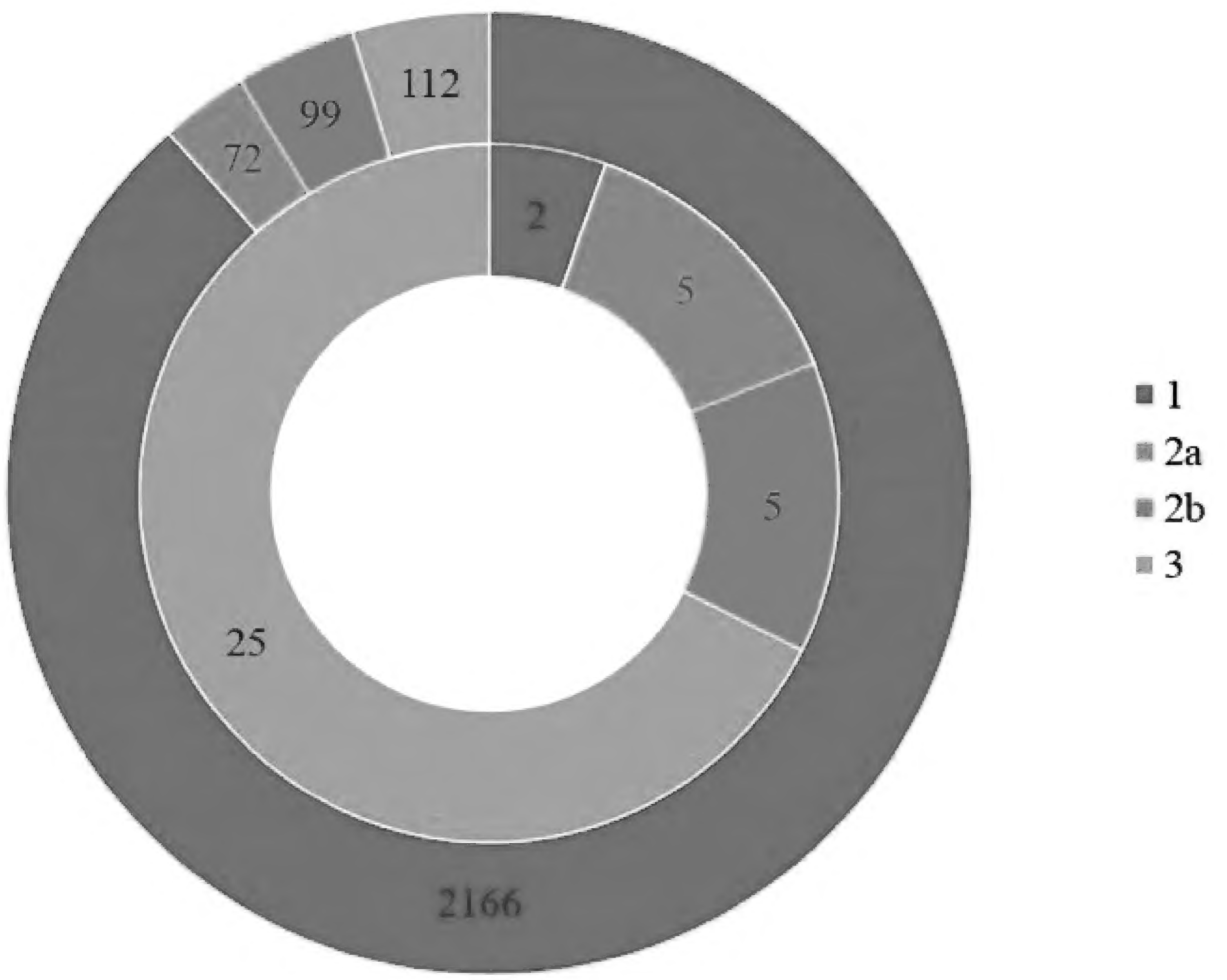

Figure 1. Proportion of ecological groups of insects by abundance (outer circle) and number of species (inner circle): 1 – specific species, 2a, 2b – facultative species (a – Detritophages; b – species feeding on pollen and honey), 3 – accidental species.

Obligate inquilines

Species whose entire life cycle is tied with bees were represented by only two species. However, they had the greatest abundance.

The greater wax moth *Galleria melonella* is a widespread pest of bee colonies, registered in 60 countries but potentially living wherever beekeeping is practiced (Kwadha et al. 2017).

In the hive, *G. mellonella* larvae feed on bee bread, honey, wax and bee brood. In the process of life, the larvae damage the honeycomb, and honey flows out of the cells through the holes. The silk threads produced by the larvae entangle the hatched young bees, which can not to move and may die of hunger. A similar phenomenon is described as galleriosis. In addition, transmission of honeybee viruses (IAPV, BQCV) and participation in the spread of foul brood diseases has been proven for *G. mellonella* (Stolbov et al. 1990; Traiyasut et al. 2016). The destructive effect of the pest is explained by its high reproductive potential and short development time (Kwadha et al. 2017).

In general, this species had a low occurrence (3.1%) in our study. This is probably due to the fact that we have studied dead bees, wax and bee bread crumb, in which *G. melonella* larvae are found relatively rarely. Females of *G. mellonella* lay eggs in crevices and cracks inside the hive, which prevents their detection, and after leaving the egg, the larvae move to the honeycomb, where they subsequently pupate (Kwadha et al. 2017). Thus, only isolated individuals can be found in the dead bees at the bottom of the hive.

The second specific species, the *Cryptophagus scanicus* beetle, is a typical inhabitant of bee hives, and predominates in numbers among symbionts in most apiaries (Sidorov 1968; Banaszak 1980; Zbanatsky 1997a; Bakalova 2011b; Skulachev 2017).

A high percentage of *C. scanicus* larval stages found in the dead bees' bed (88.4%) indicates active reproduction of this species in honey bee hives. The annual life cycle of *C. scanicus* is adapted to the inactive stages of bee colonies' life, the maximum abundance index of the species is noted in September in preparation for wintering and in April when hives are taken out (Sidorov 1968). All stages of *C. scanicus* develop in the hive (Skulachev 2017). Imago and larvae of *C. scanicus* primarily feed on hyphae of mold fungi, they can also consume bee bread, bee feces and the entrails of dead bees. Despite the fact that *C. scanicus* larvae can develop on products of non-hive origin, in this case the percentage of their death is significantly higher than when developing on honey and bee bread (Measures to control beetles 1998).

This species was the eudominant both in number and occurrence vs. all insects. It was found in 54.5% of the studied apiaries, and in these apiaries it was widespread, occupying about 70% of the hives. Based on the distribution, biology and nature of the connection with honey bees, it is possible to establish the similarity of *C. scanicus* with a small beehive beetle, *Aethina tumida*. *C. scanicus* is a species of northern origin (Sidorov 1967), and is adapted to the conditions of Western Siberia, unlike *A. tumida*, a southern species, for which the climate factor in this case is a deterrent (Schäfer et al. 2010).

Facultative inquilines

Species that are able to exist outside of hives but are regularly found in them and can develop in a hive were listed in facultative group. The species in this group mainly develop in organic-rich substrates and are often synanthropic. They probably get into hives from a human house, and find suitable conditions there, which gives them the opportunity to develop all stages in hives.

In the trophic structure, the facultative species include detritophages, and pollen- and honey-feeding species:

1. Detritophages. Among the representatives of this group, it is worth noting first of all the larder beetle *Dermestes lardarius*. This is a typical synanthropic species that live in human homes. Also, the larder beetle is regularly found in bee hives, including in Western Siberia. Beetles are able to survive the Siberian winter in honeycombs stored in unheated rooms, therefore *D. lardarius* can be considered the most cold-resistant species of beetles found in honeybee hives (Measures to control beetles 1998). We identified both adult beetles and larvae in the hives, and the latter predominated (88.5%), were among the subdominants in number and had a fairly high occurrence. In hives, *D. lardarius* feeds on dead bees and can be considered a useful scavenger species. *Cryptolestes ferrugineus* was also noted among other representatives of synanthropic Coleoptera.

Earwigs often find refuge in hives, while the most common is *Forficula auricularia*, which is classified as an apiophilic species (Sidorov 1968; Domatsky and Domatskaya 2020). We have found individual larvae of *Forficula tomis*, which was previously recorded in hives on the territory of Russia and the countries of the former USSR (Sidorov 1968; Atakishiev 1969; Bakalova 2011a). Earwigs are considered pests of beekeeping, since when high in number they plunder a noticeable amount of honey. However, there are cases of earwigs eating wax moth larvae and eggs of other harmful insects in the hive (Atakishiev 1968).

Two species of Liposcelididae family were found, of which *Liposcelis bostrychophila* had a fairly high frequency. Synanthropic species of Liposcelididae family are regularly observed everywhere in bee hives, and sometimes in significant numbers (Rolnik and Szmidt 1959).

2. Species feeding on pollen and honey. These species purposefully get into bee hives for additional nutrition with pollen and honey, as well as dead (and sometimes live) bees.

These include representatives of Hymenoptera – *Lasius niger* ants and *Vespula germanica* wasps. These insects had a high occurrence and were found in hives from different regions. They are also regularly found in hives around the world (Clapperton et al. 1989; Pusceddu et al. 2017; Pusceddu et al. 2018; Buteler et al. 2021). These insects are certainly pests, stealing food supplies from bees, however, due to their small number in hives of strong colonies, they do not cause any noticeable damage. The predatory activity of *V. germanica* is observed most often at ground level, under beehives, where

they target weak single bees falling from the hive entrance (Pusceddu et al. 2017). The relationship between bees and wasps is very interesting and requires a separate study. It is known that bees calmly react to Vespula wasps penetrating into the hive and do not attack them, unlike hornets, which hunt bees themselves and cause aggression among the latter. It has been noted that wasps can build their nests in functioning bee hives (T.F. Domatskaya, Tyumen, pers. comm.).

We conditionally include beetles of the Scirtidae family in this group. In our collections, three species of marsh beetles were found in hives – *C. padi*, *C. pubescens* and *C. variabilis* (Sazhnev et al. 2022), the latter prevailed, in terms of number and occurrence ranked the second of all insects following the eudominant *C. scanicus*.

Marsh beetle larvae develop in water and heavily moistened substrates. Adult beetles can enter hives for wintering. It is believed that adult marsh beetles do not feed, however, some species of Scirtidae (*Contacyphon coarctatus* (Paykull, 1799), *C. padi*, *Elodes minuta* (Linnaeus, 1767), *Scirtes* spp.) were found on flowering vegetation, therefore, it is possible that these beetles eat plant pollen (Sazhnev et al. 2022). Previously, *C. variabilis* was also observed in bee hives in Western Siberia (Zbanatsky 1997a). Taking into account the fact that marsh beetles were numerous in hives in our study, and were found in hives with an interval of more than 20 years, we assume that they can penetrate into hives not only for wintering but also possibly find additional food there.

Accidentals

These insects are not normally beehive-associated and enter hives accidentally, mainly in autumn, in search of shelter for wintering. Also, accidental intake into hives by beekeepers or by bees themselves from flowers can not be excluded. Representatives of this group were the most diverse in species composition and type of nutrition but they were always individually found in hives.

Most of the beetles and bugs from this group were recorded in early spring, after wintering and in late autumn. Probably, these species found themselves in hives in search of places for wintering.

Some species probably end up in hives attracted by the smell of honey. So, bumblebees were previously found in brood nests of bees (Sidorov 1968; Banaszak 1980; Bakalova 2011a). However, unlike the German wasp, bumblebees do not occur regularly in hives, so we refer them to accidental species. It is possible that *Brachypterus* beetles, which feed on the pollen of plants, also got into hives attracted by the smell of honey (Ler 1992).

Finally, aphids, larvae of cicadas of younger ages and thrips were recorded in hives. These insects feed on the sap of plants, and probably get into hives accidentally. Perhaps the latter is brought by bees when feeding on flowers (Orösi Pal 1939; Kulikov 1966).

A number of groups (Latridiidae, Staphylinidae) include species that theoretically can be obligate or facultative apiophiles due to their type of nutrition and biology features, however, due to their rarity in hives and insufficient knowledge, we tentatively assign them to a group of accidental species.

The Parasitica found in hives we tentatively also refer to this group. However, a sufficiently high number and occurrence of Parasitica makes it worth to be paid attention to. These insects can be both parasites of bees and parasites of other symbionts (in particular, *C. scanicus*). Thus, Sidorov (1968) also found a large number of Parasitica in hives in the Volga-Kama region. He considered them parasites of beetles of the *Cryptophagus* genus; however, this issue requires further study.

Conclusions

Earlier, one paper on beetles in hives of Western Siberia in the region lists 22 species of Coleoptera – symbionts of bees (Zbanatsky 1997a). Our research complements the list of 20 species of Coleoptera and other insects. Thus, at the moment, 42 species of insects have been recorded in bee hives in Western Siberia.

At the turn of the 20th and 21st centuries, the same species prevailed in the bee hives of Western Siberia – the specific commensal *C. scanicus*, the marsh beetles *C. variabilis* were numerous. These results match the results of our study. Facultative and accidental species were diverse but not numerous. At the same time, in our study did not occure *Tribolium madens*, indicated as numerous in previosly study, which can be a serious pest of hives (Zbanatsky 1997a).

The species composition and structure of bee symbionts in Western Siberia are very similar to the symbiocenoses of hives in the regions of the European part of Russia and other countries (Kazakhstan, Poland) (Rolnik and Szmidt 1959; Banaszak 1980; Semmar et al. 2014; Skulachev 2017). In most studies, a few specific species had the greatest number and occurrence. *Cryptophagus scanicus* is a typical commensal of bees, which dominates in number and occurrence in many regions. Such facultative species as ants, earwigs and the German wasp are regularly and in large numbers recorded in hives of Russia, Europe and other countries (links). The latter, which has become cosmopolitan thanks to human activities, is noted in most countries of the world, is numerous in hives and is considered one of the most dangerous pests of beekeeping.

The study of the fauna of insects living in honeybee hives should be continued, paying special attention to the role of marsh beetles and Parasitica in the structure of the symbiocenosis of bee colonies.

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Supplementary material 1

Studied apiaries in Western Siberia

Authors: Victoria V. Stolbova,Vitaly A. Stolbov

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